

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Masahiko HIROSE
Serial No.:
Filed :
Title : Highly Permeable Composite Reverse Osmosis Membrane and Method of
Producing the Same

Art Unit :
Examiner :

Assistant Commissioner for Patents
Washington, DC 20231

PRELIMINARY AMENDMENT

Dear Sir:

Please amend this application as follows:

IN THE SPECIFICATION

Please amend the specification as follows [**A marked up copy of the Specification is provided as Appendix A**]:

Please insert the following paragraph on page 1, above the heading "Field of the Invention":

--This application is a continuation application of U.S. Application Serial No.09/452,731 filed December 1, 1999.--

Please amend the paragraph starting on line 18 of page 7 as follows:

An aqueous solution including 2 weight % of polyvinyl alcohol-based amine compound having a side chain amino group represented by Formula 4, 0.5 weight % of sodium lauryl sulfate and 0.5 weight % of sodium hydrocarbon was applied on a polysulfone-based ultrafilteration membrane (microporous support) before removing extra aqueous solution, so that a layer of the aqueous solution was formed on the support:

Please amend the paragraph starting on line 35 of page 1 as follows:

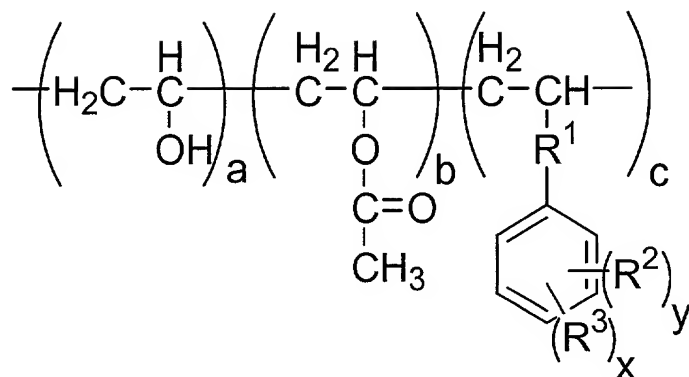
However, these membranes have a salt rejection factor greater than 90%, and the permeable water quantity is no more than $0.2 \text{ m}^3 / \text{m}^2 \cdot \text{d} \cdot \text{kg} / \text{cm}^2$. This indicates that the permeable water quantity level is as low as $0.4 \text{ m}^3 / \text{m}^2 \cdot \text{d}$ at a pressure level of city water ($2 \text{ kg} / \text{cm}^2$). When such membranes are used, the membrane area should be enlarged or pumps should be employed to raise pressure to obtain a proper permeable water quantity. Because these materials reject such a high percentage of salt, salt concentration in the concentrated water is increased at an operation with a high recovery rate, so that insoluble ingredients such as CaCO_3 and SiO_2 are deposited on the membrane surface and cause troubles such as a decrease in permeable water quantity.

IN THE CLAIMS

Please amend the claims as follows [A marked up copy of the claims is provided in Appendix B]:

1. (Once Amended) A highly permeable composite reverse osmosis membrane comprising a thin film and a microporous support to support the thin film;
wherein the thin film is formed by reacting a (a) component with a (b) component, the (a) component, as represented by Formula 1, having a main chain of polyvinyl alcohol and a side chain comprising at least one amino group selected from the group consisting of primary amines; and the (b) component comprising at least one substantially monomeric compound having at least two groups that react with the amino groups.

Formula 1



wherein $2 \leq a$, $0 \leq b$, $2 < c$, $1 \leq x \leq 5$, $0 \leq y \leq 4$, R^1 is at least one group selected from the group consisting of an ether group, an alkylene group, and an ester group; R^2 is at least one group selected from the group consisting of an alkyl group and a halogen group; and R^3 is a primary amine.

4. (Once Amended) The highly permeable composite reverse osmosis membrane according to claim 1, wherein the (b) component is an acid chloride.
5. (Once Amended) The highly permeable composite reverse osmosis membrane according to claim 4, wherein the (b) component is at least one polyfunctional acid chloride compound selected from the group consisting of aromatic, aliphatic, and alicyclic polyfunctional acid halide compounds.
6. (Once Amended) The highly permeable composite reverse osmosis membrane according to claim 1 having a permeable flux of at least $1.0 \text{ cm}^3/\text{m}^2\cdot\text{d}$ as assessed with a pH 6.5 aqueous solution comprising 500 mg/liter of sodium chloride at an operation pressure of 5 kg/cm^2 and at a temperature of 25°C .
7. (Once Amended) The highly permeable composite reverse osmosis membrane according to claim 1 having a salt rejection of no more than 80% as assessed with a pH 6.5

aqueous solution comprising 500 mg/liter of sodium chloride at an operation pressure of 5 kg/cm² and at a temperature of 25 °C.

Please cancel claims 2, 3, 8 and 9.

REMARKS

The present application is a continuation of U.S. Application No. 09/452,731. In the parent application, the Examiner raised several 35 U.S.C. § 112 issues with respect to the applicant's specification and claims 1 and 3-7. The Applicant has filed a continuation application in order to provide more time to clarify the issues surrounding this application. Please reconsider this application in view of the claim amendments made above and the following remarks.

I. Amendments to the Specification

The amendments to the Specification have been made to correct minor typographical errors discovered in reviewing the text. No new matter has been added by way of these amendments.

II. Disposition of Claims

Claims 1-9 are currently pending in the application. Claims 2, 3, 8, and 9 have been cancelled. Claims 1, and 4-7 have been amended to clarify the scope of the Applicant's invention. No new matter has been added by way of the amendments. Support for the added Formula 1 may be found, for example, on page 3 of Applicant's originally filed specification. The NH₂ appearing in that formula has been replaced by R³ to clarify that the Applicant's invention relates to the use of primary amines. The value of "a" in the formula has been

amended to reflect that a main chain of *polyvinyl* alcohol requires that at least two PVA repeat units be present in the polymer.

III. 35 U.S.C. § 112 issues

The Applicant's invention relates to a highly permeable composite reverse osmosis membrane, which may be crosslinked. In one embodiment, a polymer having a side chain including a primary amino group is used. A polyfunctional acid halide can be added to the polymer, resulting in a chemical bond forming between the acid halide and the primary amine. As a result of this, the polymer chains become chemically entangled. In one embodiment, the amine compound has a formula as illustrated by Formula 4 on page 7 of the Specification. Notably, the values of a, b, and c described by that formula merely represent the ratios of starting monomer used, and are not meant to represent a specific monomer sequence of 518 units.

In the parent application, the Examiner objected to the Applicant's Specification as failing to provide an enabling disclosure because the application allegedly did not teach one of ordinary skill in the art how to assemble 518 monomer units. This rejection is respectfully traversed. The Applicant believes that the Examiner assumed that the "a", "b", and "c" values represent the actual number of monomer units. In actuality, however, the "a", "b", and "c" values represent a ratio of starting monomer units, and is not meant to represent a specific number of repeat units. In support of the Applicant's argument, the Applicant submits herewith an affidavit under 37 C.F.R. § 1.132. The affidavit sets forth that it is well known in the field of polymer chemistry that polymers are prepared by mixing starting monomers with a desired ratio before initiating the polymerization process. Once the reaction starts, one cannot control the specific sequence of the final polymer products.

In light of this knowledge, one of ordinary skill in the art would know that Formula 4 (the disclosed preferred embodiment) simply indicates the relative ratios of the starting monomers. Accordingly, the affidavit describes that the monomers were added in this ratio, and the resultant polymer was analyzed. The analyzed data clearly show a polymer having a structure in accordance with the structure shown in Formula 4. Because the Specification must be read in light of the knowledge of one of ordinary skill in the art, the Applicant respectfully requests the withdrawal of any § 112 rejections pertaining to lack of an enabling disclosure.

Amended claim 1 recites a structure in accordance with the scope of the present invention, which includes the structure shown in Formula 4. As another matter, the Applicant notes that the “x” and “y” associated with Formula 1 relate to the number of substituents on the benzene ring. That is, when “x” equals five, five primary amine substituents exist on the benzene ring.

IV. Conclusion

The Applicant believes this application to be patentable over the prior art, and respectfully requests favorable action in the form of a Notice of Allowance. The Applicant further requests that should the Examiner have any questions surrounding the instant application, that the Examiner please contact the undersigned.

Please apply any charges not covered, or any credits, to Deposit Account 50-0591

(Reference No. 04558.035002).

Respectfully Submitted,

Date: _____

u/slo



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APPENDIX A: MARKED-UP COPY OF THE SPECIFICATION

Please amend the paragraph starting on line 18 of page 7 as follows:

An aqueous solution including 2 weight % of polyvinyl alcohol-based amine compound having a side chain amino group represented by Formula [5] 4, 0.5 weight % of sodium lauryl sulfate and 0.5 weight % of sodium hydrocarbon was applied on a polysulfone-based ultrafilterartion membrane (microporous support) before removing extra aqueous solution, so that a layer of the aqueous solution was formed on the support:

Please amend the paragraph starting on line 35 of page 1 as follows:

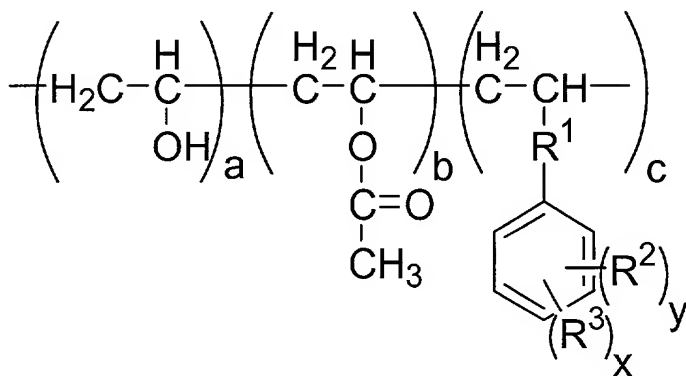
However, these membranes have a salt rejection factor greater than 90%, and the permeable water quantity is no more than $[0.2\text{m}^2]$ $0.2\text{ m}^3/\text{m}^2\cdot\text{d}\cdot\text{kg}/\text{cm}^2$. This indicates that the permeable water quantity level is as low as $0.4\text{m}^3/\text{m}^2\cdot\text{d}$ at a pressure level of city water ($2\text{kg}/\text{cm}^2$). When such membranes are used, the membrane area should be enlarged or pumps should be employed to raise pressure to obtain a proper permeable water quantity. Because these materials reject such a high percentage of salt, salt concentration in the concentrated water is increased at an operation with a high recovery rate, so that insoluble ingredients such as CaCO_3 and SiO_2 are deposited on the membrane surface and cause troubles such as a decrease in permeable water quantity.

APPENDIX B: MARKED-UP COPY OF THE CLAIMS CLAIMS

1. (Once Amended) A highly permeable composite reverse osmosis membrane comprising a thin film and a microporous support to support the thin film[,];

wherein the thin film is formed by reacting a (a) [an amine] component with a (b) component, the (a) component, as represented by Formula 1, having a main chain of polyvinyl alcohol and a side chain comprising at least one amino group selected from the group consisting of primary amines, [comprising at least one polyvinyl alcohol-based amine compound having at least two primary and secondary side chain amino groups]; and the (b) [a] component comprising at least one substantially monomeric compound having at least two groups that react with the amino group.

Formula 1



wherein $2 \leq a$, $0 \leq b$, $2 < c$, $1 \leq x \leq 5$, $0 \leq y \leq 4$, R^1 is at least one group selected from the group consisting of an ether group, an alkylene group, and an ester group; R^2 is at least one group selected from the group consisting of an alkyl group and a halogen group; and R^3 is a primary amine.

4. (Once Amended) The highly permeable composite reverse osmosis membrane according to claim 1, wherein the (b) **[compound]** component is an acid halide.

5. (Once Amended) The highly permeable composite reverse osmosis membrane according to claim 4, wherein the (b) **[compound]** component is at least one polyfunctional acid

halide compound selected from the group consisting of aromatic, aliphatic, and alicyclic polyfunctional acid halide compounds.

6. (Once Amended) The highly permeable composite reverse osmosis membrane according to claim 1[, **wherein the**] having a permeable flux [is] of at least $1.0 \text{ cm}^3/\text{m}^2\cdot\text{d}$ [**at an evaluation where**] as assessed with a pH 6.5 aqueous solution comprising 500 mg/liter of sodium chloride [**is used**] at an operation pressure of $5 \text{ kg}/\text{cm}^2$ and at a temperature of 25°C .

7. (Once Amended) The highly permeable composite reverse osmosis membrane according to claim 1[, **wherein the**] having a salt rejection [is] of no more than 80% [**at an evaluation where**] as assessed with a pH 6.5 aqueous solution comprising 500 mg/liter of sodium chloride [**is used**] at an operation pressure of $5 \text{ kg}/\text{cm}^2$ and at a temperature of 25°C .